AD-A144 997 NORMAL APPROXIMATION FOR RESPONSE TIME IN A PROCESSOR-SHARED COMPUTER SYSTEM MODEL(U) NAVAL POSTGRADUATE SCHOOL MONTEREY CA S PORNSURIYA MAR 84 2/2

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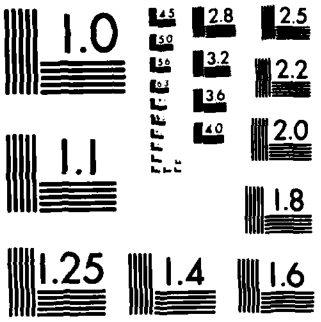

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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101   CONTINUE                                                          APP01390
102 CONTINUE                                                            APP01400
    DO 103 J=1,N                                                        APP01410
      PI(1,(J+1))=GAMMA((FLOAT(N+1)))/GAMMA((FLOAT(N-J+1)))             APP01420
      PI(1,(J+1))=PI(1,(J+1))*(LAM2/MU2)**J                             APP01430
103 CONTINUE                                                            APP01440
    DO 104 I=1,M                                                        APP01450
      PI((I+1),1)=GAMMA((FLOAT(M+1)))/GAMMA((FLOAT(M-I+1)))             APP01460
      PI((I+1),1)=PI((I+1),1)*(LAM1/MU1)**I                             APP01470
104 CONTINUE                                                            APP01480
    PI(1,1) = 0.                                                        APP01490
    DO 120 I=1,M1                                                       APP01500
      DO 110 J=1,N1                                                     APP01510
        PI(1,1) = PI(1,1)+PI(I,J)                                       APP01520
110   CONTINUE                                                          APP01530
120 CONTINUE                                                            APP01540
    PI(1,1) = 1./(PI(1,1)+1.)                                           APP01550
    DO 140 I=1,M1                                                       APP01560
      DO 13C J=1,N1                                                     APP01570
       IF ( (I .EQ. 1) .AND. (J .EQ. 1)) GO TO 130                      APP01580
        PI(I,J) = PI(1,1)*PI(I,J)                                       APP01590
130   CONTINUE                                                          APP01600
140 CONTINUE                                                            APP01610
    DO 180 I=1,M1                                                       APP01620
      DO 170 J=1,N1                                                     APP01630
        TU1(I,J) = PI( I,J)*LAM1*(M1-I)                                 APP01640
170   CONTINUE                                                          APP01650
180 CONTINUE                                                            APP01660
    Q1 = 0.                                                             APP01670
    DO 200 I=1,M1                                                       APP01680
      DO 190 J=1,N1                                                     APP01690
        Q1 = Q1+TU1(I, J)                                               APP01700
190   CONTINUE                                                          APP01710
200 CONTINUE                                                            APP01720
    Q1 = 1./Q1                                                          APP01730
    DO 220 I=1,M1                                                       APP01740
      DO 210 J=1,N1                                                     APP01750
        TU1(I,J) = TU1(I,J)*Q1                                          APP01760
210   CONTINUE                                                          APP01770
220 CONTINUE                                                            APP01780
    DO 225 J=1,N1                                                       APP01790
      NU1(1,J) = 0.                                                     APP01800
225 CONTINUE                                                            APP01810
    DO 232 I=2,M1                                                       APP01820
      DO 231 J=1,N1                                                     APP01830
        NU1(I,J) = TU1((I-1),J)                                         APP01840
231   CONTINUE                                                          APP01850
232 CONTINUE                                                            APP01860
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  235 CONTINUE
      RETURN
      END
C
C ****************************************************
C SUBROUTINE TO SIMULATE RESPONSE TIME AND COMPARISON TO CLT
C ****************************************************
      SUBROUTINE SIMRT(M,N,T,LAM1,LAM2,MU1,MU2,X1,A1,B1,C1
     *,PR1,VARP,PH1,VPH,HTXB,HTSD,QH)
      REAL *4 W0,C0,T,LAM1,LAM2,MU1,MU2,R1(5,6),XR(1000),AR1(6,6)
     *,LJ1(6),LJ2(6),MJ1(6),MJ2(6),EXP(6),XJ,XL,XM,BR1(5,6),CR1(5,6)
     *,EXP1,EXP2,EXP3,EXP4,X1(6,6),A1(6,6),B1(6,6),C1(6,6)
     *,QU(7),CI(7),PK1(7),PK3(7),PR1(7),PH1(7),VARP(7),DMY(7),QH(7)
     *,VPH(7),DNY(7),NU1(6,6),XBLT,SDLT,HTXB,HTSD
      INTEGER IX1,IX2,M,N,M1,N1,KT,K1(7),K3(7)
      IX1 = 253766
      IX2 = 344921
      M1 = M+1
      N1 = N+1
      KT = 300
      DO 10 I=1,M1
        LJ1(I) = (M1-I)*LAM1
        MJ1(I) = MU1*(I-1)
   10 CONTINUE
      DO 11 J=1,N1
        LJ2(J) = (N1-J)*LAM2
        MJ2(J) = MU2*(J-1)
   11 CONTINUE
C CALL SUBROUTINE TO COMPUTE STEADY-STATE DISTRIBUTION
      CALL SST(M,N,LAM1,LAM2,MU1,MU2,NU1)
C STD. NORMAL QUANTILES (.10,.25,.50,.75,.90,.95,.99)
      QU(1) = -1.2816
      QU(2) = -0.6745
      QU(3) = 0.
      QU(4) = 0.6745
      QU(5) = 1.2816
      QU(6) = 1.6449
      QU(7) = 2.3263
C CALL SUBROUTINE TO READ CLT MEAN AND VARIANCE
      CALL APPROX(XBLT,SDLT)
      XBLT = XBLT*T
      SDLT = SQRT(SDLT*T)
C CALL SUBROUTINE TO COMPUTE HEAVY TRAFFIC MEAN AND VARIANCE
      CALL HTA2(T,M,N,LAM1,LAM2,MU1,MU2,HTXB,HTSD)
      HTSD = SQRT(HTSD)
      DO 13 I=1,7
        QI(I) = XBLT+SDLT*QU(I)
        PR1(I) = 0.
      VARP(I) = 0.
      QH(I) = HTXB +HTSD*QU(I)
      PH1(I) = 0.
      VPH(I) = 0.
   13 CONTINUE
C
C CONDITIONAL RESPONSE TIME
    DO 25 NI=1,M
     DO 24 NJ=1,N1
      R1(NI,NJ) = 0.
      AR1(NI,NJ) = 0.
      BR1(NI,NJ) = 0.
      CR1(NI,NJ) = 0.
   24  CONTINUE
   25 CONTINUE
    DO 250 I=1,M
      DO 240 J=1,N1
       DO 230 K=1,KT
        WO = T
        CO = 0.
        IO = I
        JO = J
C
C GENERATE EXPONENTIAL ARRIVAL AND DEPARTURE TIME
   30   CALL LEXPN(IX1 ,EXP,6,1 ,0)
C
        IF ( IO .NE. M ) GO TO 50
          EXP1 = 9999.99
          IF ( IO .NE. 1 ) GO TO 38
            EXP3 = 9999.99
            GO TO 39
   38     EXP3 = EXP(3)/(MU1*(IO-1))
   39     IF ( JO .NE. 1 ) GO TO 40
            EXP2 = EXP(2)/(LJ2(JO)*(IO+JO-1))
            XL = EXP(5)/((LJ1(IO+1)+LJ2(JO))*(IO+JO-1))
            EXP4 = 9999.99
            XM = EXP3
            GO TO 110
   40     IF ( JO .NE. N1 ) GO TO 41
            EXP2 = 9999.99
            XL = EXP1
            EXP4 = EXP(4)/(MU2*(JO-1))
            XM = EXP(6)/(MU1*(IO-1)+MU2*(JO-1))
          GC TO 110
   41     EXP2 = EXP(2)/(LJ2(JO)*(IO+JO-1))
          XL = EXP(5)/((LJ1(IO+1)+LJ2(JO))*(IO+JO-1))
          EXP4 = EXP(4)/(MU2*(JO-1))
          XM = EXP(6)/(MU1*(IO-1)+MU2*(JO-1))
          GO TO 110                                                     APP02830
 50     IF ( IO .NE. 1 ) GO TO 55                                       APP02840
          EXP1 = EXP(1)/(LJ1(IO+1)*(IO+JO-1))                           APP02850
          EXP3 = 9999.99                                                APP02860
          GO TO 39                                                      APP02870
 55     EXP1 = EXP(1)/(LJ1(IO+1)*(IO+JO-1))                             APP02880
        EXP3 = EXP(3)/(MU1*(IO-1))                                      APP02890
        GO TO 39                                                        APP02900
110     XJ = AMIN1(XL,XM)                                               APP02910
        IF ( XJ .LT. WO ) GO TO 120                                     APP02920
          R1(I,J) = R1(I,J)+(CO+WO*(IO+JO-1))/(FLOAT(KT))               APP02930
          XR(K) = CO+WO*(IO+JO-1)                                       APP02940
          GC TO 220                                                     APP02950
120     CO = CO+XJ*(IO+JO-1)                                            APP02960
        WO = WO-XJ                                                      APP02970
        IF ( XJ .NE. XL ) GO TO 140                                     APP02980
          IF ( EXP1 .GT. EXP2 ) GO TO 130                               APP02990
           IF ( IO .EQ. M ) GO TO 160                                   APP03000
            IO = IO+1                                                   APP03010
            GO TO 160                                                   APP03020
130       IF ( JO .EQ. N1 ) GO TO 160                                   APP03030
           JO = JO+1                                                    APP03040
           GO TO 160                                                    APP03050
140     IF ( EXP3 .GT. EXP4 ) GO TO 150                                 APP03060
         IF ( IO .EQ. 1 ) GO TO 160                                     APP03070
          IO = IO-1                                                     APP03080
          GO TO 160                                                     APP03090
150     IF ( JO .EQ. 1) GO TO 160                                       APP03100
         JO = JO-1                                                      APP03110
160     IX1 = IX1+1                                                     APP03120
        GO TO 30                                                        APP03130
220     CONTINUE                                                        APP03140
230   CONTINUE                                                          APP03150
      DO 231 LI=1,7                                                     APP03160
        K1(LI) = 0                                                      APP03170
        K3(LI) = 0                                                      APP03180
231   CONTINUE                                                          APP03190
      DO 235 K=1,KT                                                     APP03200
        AR1(I,J) = AR1(I,J)+(XR(K)-R1(I,J))**2/(FLOAT(KT))              APP03210
        BR1(I,J) = BR1(I,J)+(XR(K)-R1(I,J))**3/(FLOAT(KT))              APP03220
        CR1(I,J) = CR1(I,J)+(XR(K)-R1(I,J))**4/(FLOAT(KT))              APP03230
        IF( XR(K) .GT. QI(1) ) GO TO 355                                APP03240
          DO 350 LI=1,7                                                 APP03250
            K1(LI) = K1(LI)+1                                           APP03260
350       CCNTINUE                                                      APP03270
          GO TO 400                                                     APP03280
355     IF( XR(K) .GT. QI(2) ) GO TO 360                                APP03290
          DC 357 LI=2,7                                                 APP03300
         K1(LI) = K1(LI)+1                                              APP03310
   357  CCNTINUE                                                        APP03320
        GO TO 400                                                       APP03330
   360 IF( XR(K) .GT. QI(3) ) GO TO 365                                 APP03340
        DO 363 LI=3,7                                                   APP03350
         K1(LI) = K1(LI)+1                                              APP03360
   363  CCNTINUE                                                        APP03370
        GO TO 400                                                       APP03380
   365 IF( XR(K) .GT. QI(4) ) GO TO 370                                 APP03390
        DC 367 IL=4,7                                                   APP03400
         K1(IL) = K1(IL)+1                                              APP03410
   367  CCNTINUE                                                        APP03420
        GO TO 400                                                       APP03430
   370 IF( XR(K) .GT. QI(5) ) GU TO 375                                 APP03440
        DO 372 KI=5,7                                                   APP03450
         K1(KI) = K1(KI)+1                                              APP03460
   372  CCNTINUE                                                        APP03470
        GO TO 400                                                       APP03480
   375 IF( XR(K) .GT. QI(6) ) GO TO 380                                 APP03490
        DC 377 LK=6,7                                                   APP03500
         K1(LK) = K1(LK)+1                                              APP03510
   377  CCNTINUE                                                        APP03520
        GC TO 400                                                       APP03530
   380 IF( XR(K) .GT. QI(7) ) GO TO 400                                 APP03540
         K1(7) = K1(7)+1                                                APP03550
   400 CONTINUE                                                         APP03560
   235CONTINUE                                                          APP03570
      DO 800 MI=1,KT                                                    APP03580
       IF( XR(MI) .GT. QH(1) ) GO TO 710                                APP03590
        DO 705 MK=1,7                                                   APP03600
         K3(MK) = K3(MK)+1                                              APP03610
   705  CONTINUE                                                        APP03620
        GC TO 780                                                       APP03630
   710 IF( XR(MI) .GT. QH(2) ) GO TO 720                                APP03640
        DC 715 MKK=2,7                                                  APP03650
         K3(MKK) = K3(MKK)+1                                            APP03660
   715  CCNTINUE                                                        APP03670
        GC TO 780                                                       APP03680
   720 IF( XR(MI) .GT. QH(3) ) GO TO 730                                APP03690
        DO 725 MKI=3,7                                                  APP03700
         K3(MKI) = K3(MKI)+1                                            APP03710
   725  CCNTINUE                                                        APP03720
        GC TO 780                                                       APP03730
   730 IF( XR(MI) .GT. QH(4) ) GO TO 740                                APP03740
        DO 735 MKJ=4,7                                                  APP03750
         K3(MKJ) = K3(MKJ)+1                                            APP03760
   735  CCNTINUE                                                        APP03770
        GO TO 780                                                       APP03780
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74C     IF( XR(MI) .GT. QH(5) ) GO TO 750                               APP03790
          CO 745 MKL=5,7                                                APP03800
            K3(MKL) = K3(MKL)+1                                         APP03810
745       CONTINUE                                                      APP03820
          GC TO 780                                                     APP03830
750     IF( XR(MI) .GT. QH(6) ) GO TO 760                               APP03840
          DO 755 MKM=6,7                                                APP03850
            K3(MKM) = K3(MKM)+1                                         APP03860
755       CCNTINUE                                                      APP03870
          GC TO 780                                                     APP03880
760     IF( XR(MI) .GT. QH(7) ) GO TO 780                               APP03890
          K3(7) = K3(7)+1                                               APP03900
780     CONTINUE                                                        APP03910
800   CONTINUE                                                          APP03920
      DO 410 KK=1,7                                                     APP03930
        PK1(KK) = FLOAT(K1(KK))/FLOAT(KT)                               APP03940
        PK3(KK) = FLOAT(K3(KK))/FLOAT(KT)                               APP03950
410   CONTINUE                                                          APP03960
      DO 420 LM=1,7                                                     APP03970
        PR1(LM) = PR1(LM)+PK1(LM)*NU1((I+1),J)                          APP03980
        PH1(LM) = PH1(LM)+PK3(LM)*NU1((I+1),J)                          APP03990
420   CONTINUE                                                          APP04000
240  CONTINUE                                                           APP04010
250 CONTINLE                                                            APP04020
    DO 425 LL=1,7                                                       APP04030
     IF(PR1(LL) .GT. 1.0) GO TO 200                                     APP04040
       GO TO 201                                                        APP04050
200  PR1(LL) = 1.0                                                      APP04060
201  IF(PH1(LL) .GT. 1.0) PH1(LL) = 1.0                                 APP04070
     DO 424 II=1,M                                                      APP04080
      DO 423 JJ=1,N1                                                    APP04090
       DMY(LL) = PR1(LL)*(1-PR1(LL))*NU1((II+1),JJ)**2/FLOAT(KT)        APP04100
       VARP(LL) = VARP(LL)+DMY(LL)                                      APP04110
       DNY(LL) = PH1(LL)*(1-PH1(LL))*NU1((II+1),JJ)**2/FLOAT(KT)        APP04120
       VPH(LL) = VPH(LL)+DNY(LL)                                        APP04130
423   CONTINUE                                                          APP04140
424  CONTINUE                                                           APP04150
425 CONTINUE                                                            APP04160
490 CONTINUE                                                            APP04170
    DO 310 JJJ=1,N1                                                     APP04180
      X1(1,JJJ) = 0.                                                    APP04190
      A1(1,JJJ) = 0.                                                    APP04200
      B1(1,JJJ) = 0.                                                    APP04210
      C1(1,JJJ) = 0.                                                    APP04220
310 CONTINUE                                                            APP04230
    DO 320 IK=1,M                                                       APP04240
      DO 319 JK=1,N1                                                    APP04250
        X1((IK+1),JK) = R1(IK,JK)                                       APP04260
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          A1((IK+1),JK) = AR1(IK,JK)                                    APP04270
          B1((IK+1),JK) = BR1(IK,JK)                                    APP04280
          C1((IK+1),JK) = CR1(IK,JK)                                    APP04290
  319   CONTINUE                                                        APP04300
  320 CONTINUE                                                          APP04310
      RETURN                                                            APP04320
      END                                                               APP04330
C                                                                       APP04340
C****************************************************************       APP04350
C SUBROUTINE TO READ CLT. MEAN AND VARIANCE                             APP04360
C****************************************************************       APP04370
      SUBROUTINE APPROX(XBLT,SDLT)                                      APP04380
      REAL XBLT,SDLT                                                    APP04390
C READ RESULTS FROM APL PROGRAM GIVEN M,N,LAM1,LAM2,MU1,MU2             APP04400
      XBLT = 7.170168127                                                APP04410
      SDLT = C.05611889739                                              APP04420
      RETURN                                                            APP04430
      END                                                               APP04440
C                                                                       APP04450
C****************************************************************       APP04460
C SUBROUTINE TO COMPUTE HEAVY TRAFFIC MEAN AND VARIANCE                 APP04470
C****************************************************************       APP04480
      SUBROUTINE HTA2(T,M,N,LAM1,LAM2,MU1,MU2,HTXB,HTSD)                APP04490
      REAL T,LAM1,LAM2,MU1,MU2,HTXB,HTSD,XL1,XL2,XC,AA,BB,CC            APP04500
     *,XM1,XM2,AS1,AS2,BS1,BS2,SM1,SM2,S0,S1,B11,B12,B21,B22            APP04510
     *,K11,K12,K21,K22,G31,G32,B31,B32,K31,K32,Y10,Y20,Y12              APP04520
     *,ZT1,ZT2,DZ1,DZ2,DZ3,DT1,DT2,DT3,DS1,DS2,DS3,D10,D20              APP04530
      INTEGER M,N                                                       APP04540
      XL1 = LAM1*M                                                      APP04550
      XL2 = LAM2*N                                                      APP04560
      XC = FLCAT(N)/FLOAT(M)                                            APP04570
      AA = XL1*(MU1*XL2-MU2*XL1)                                        APP04580
      BB = MU2*XL1**2+(MU1-XL1)*(MU1*XL2-MU2*XL1)+XC*XL2*XL1*MU1        APP04590
      CC = XL1*MU2*(MU1-XL1)-XL2*XL1*XC*MU1                             APP04600
      IF( MU1*XL2-MJ2*XL1 ) 100,110,100                                 APP04610
  100   XM1 = (SQRT(BB**2-4*AA*CC)-BB)/(2*AA)                           APP04620
        GO TO 200                                                       APP04630
  110 XM1 = -CC/BB                                                      APP04640
  200 XM2 = XM1*MU1/(XL1*(1-XM1))-XM1                                   APP04650
C COMPUTE THE MEAN                                                      APP04660
      HTXB = M*(XM1+XM2)*T                                              APP04670
C                                                                       APP04680
      AS2 = -XL1*(1-XM1)                                                APP04690
      BS1 = -XL2*(XC-XM2)                                               APP04700
      AS1 =  XL1*(XM1+XM2)+MU1+AS2                                      APP04710
      BS2 =  XL2*(XM1+XM2)+MU2+BS1                                      APP04720
      SM1 =  SQRT(XM1*MU1-AS2*(XM1+XM2))                                APP04730
      SM2 =  SQRT(XM2*MU2-BS1*(XM1+XM2))                                APP04740
      SO  = (SCRT((BS2+AS1)**2-4*(AS1*BS2-AS2*BS1))-BS2-AS1)/2.                APP04750
      S1  = -(BS2+AS1+SO)                                                       APP04760
      B11 =  (SO+BS2)/(SO-S1)                                                   APP04770
      B21 =  BS1/(S1-SO)                                                        APP04780
      B12 =  AS2/(S1-SO)                                                        APP04790
      B22 =  (SO+AS1)/(SO-S1)                                                   APP04800
      K11 =  (S1+BS2)/(S1-SO)                                                   APP04810
      K22 =  (S1+AS1)/(S1-SO)                                                   APP04820
      K12 =  AS2/(SO-S1)                                                        APP04830
      K21 =  BS1/(SO-S1)                                                        APP04840
      G31 =  (BS2-BS1)/(SO*S1)                                                  APP04850
      G32 =  (AS1-AS2)/(SO*S1)                                                  APP04860
      B31 =  (G31*S1+1)/(SO-S1)                                                 APP04870
      B32 =  (G32*S1+1)/(SO-S1)                                                 APP04880
      K31 =  (G31*SO+1)/(S1-SO)                                                 APP04890
      K32 =  (G32*SO+1)/(S1-SO)                                                 APP04900
      Y10 =  -SM1**2*(B11**2/(2*SO)+2*B11*K11/(SO+S1)+K11**2/(2*S1))            APP04910
      Y10 =  Y10-SM2**2*(B12**2/(2*SO)+2*B12*K12/(SO+S1)+K12**2/(2*S1))         APP04920
      Y20 =  -SM1**2*(B21**2/(2*SO)+2*B21*K21/(SO+S1)+K21**2/(2*S1))            APP04930
      Y20 =  Y20-SM2**2*(B22**2/(2*SO)+2*B22*K22/(SO+S1)+K22**2/(2*S1))         APP04940
      D10 =  B11*B21/(2*SO)+(K11*B21+B11*K21)/(SO+S1)+K11*K21/(2*S1)            APP04950
      D20 =  B12*B22/(2*SO)+(K12*B22+B12*K22)/(SO+S1)+K12*K22/(2*S1)            APP04960
      Y12 =  -SM1**2*D10-SM2**2*D20                                             APP04970
      DS1 =  B31**2*(EXP(2*SO*T)-1)/(2*SO)+K31**2*(EXP(2*S1*T)-1)/(2*S1)        APP04980
      DS2 =  2*G31*B31*(EXP(SO*T)-1)/SO+2*G31*K31*(EXP(S1*T)-1)/S1              APP04990
      DS3 =  G31**2*T+2*B31*K31*(EXP((SO+S1)*T)-1)/(SO+S1)                      APP05000
      ZT1 =  CS1+DS2+DS3                                                        APP05010
      DT1 =  B32**2*(EXP(2*SO*T)-1)/(2*SO)+K32**2*(EXP(2*S1*T)-1)/(2*S1)        APP05020
      DT2 =  2*G32*B32*(EXP(SO*T)-1)/SO+2*G32*K32*(EXP(S1*T)-1)/S1              APP05030
      DT3 =  G32**2*T+2*B32*K32*(EXP((SO+S1)*T)-1)/(SO+S1)                      APP05040
      ZT2 =  DT1+DT2+DT3                                                        APP05050
      DZ1 =  (G31+B31*EXP(SO*T)+K31*EXP(S1*T))**2*Y10                           APP05060
      DZ2 =  (G32+B32*EXP(SO*T)+K32*EXP(S1*T))**2*Y20                           APP05070
      DZ3 =  2*SQRT(DZ1/Y10)*SQRT(DZ2/Y20)*Y12                                  APP05080
C COMPUTE THE VARIANCE                                                          APP05090
      HTSD = (DZ1+DZ2+DZ3+ZT1*SM1**2+ZT2*SM2**2)*M                              APP05100
C                                                                               APP05110
      RETURN                                                                    APP05120
      END                                                                       APP05130
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